OFFICE WORKSTATION USE

by

ADMINISTRATIVE MANAGERS AND PROFESSIONALS

Christine V. Bullen

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CISR WP #102

Sloan WP #1434-83

Center for Information Systems Research

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ABSTRACT: A previous report described a case study of an office environment to determine requirements needed to support secretarial use of office workstations. This new study reports observations on the work patterns of 18 administrative managers and professionals as they use computer-based function at the San Jose Research Laboratory. Data was gathered through structured interviews based on use of the Critical Success Factors method and the Office Analysis Methodology. Observations are given on the variety and diversity of tasks within jobs, use of the message system to avoid "telephone tag", appropriate measures for productivity, and the potential for support from Information Centers. General requirements are described for 1) reliable system operation, 2) flexible access to a variety of services, 3) finding information from diverse sources, and 4) support for scanning behavior. These requirements are compared with those observed in the earlier study of secretarial workstation use.

INTRODUCTION

Much has appeared in print lately about the "office of the future". Often this writing is based on an extension of the ideas and stereotypes which are used to talk about the office of today. In order to understand the nature of office work and thereby to support office workers of both today and the future, the MIT Center for Information Systems Research (CISR) and the IBM San Jose Research Laboratory (SJRL) established a joint research project. The purpose of this research is to understand what it is that office workers at all levels and in all roles are trying to accomplish. In particular, are there office tasks where computer support can be used to facilitate what people do as they carry out their work? The understanding necessary to answer this question is developed through interviews of office workers to elicit the missions, procedures, and tasks carried out in offices.

The first part of this research, reported in the IBM Systems Journal (Ref. 1), focussed on a view of the secretarial and support functions provided at one research site, obtained by interviewing a "horizontal" sample of the personnel. Two major outcomes of that research are:

1) Traditional stereotypes place artificial bounds on secretarial work. These stereotypes seem to be oversimplifications; secretaries can accomplish "non-clerical" results when provided with appropriate tools to facilitate their work. Indeed, advanced technology can have a "leveling" effect in that professional and managerial staff may find it cost effective (in terms of elapsed time and quality of the result) to do some "clerical" tasks if they are given efficient tools to support those activities.

2) Specific workstation requirements were identified for

- a large-screen word-processor with local storage (programmable so that functions can be tailored to user needs),
- attachment of the word processor to host and network services (for high quality printed output and for user communication with remote locations),
- typewriter emulation on the word processor (for handling one-time paper forms from outside the office),
- task switching between multiple tasks which may be active in parallel, and
- built-in local support programs and aids (e.g., for training).

The requirements led to the development of a prototype system which is currently being tested.

In this paper we present the results of the second phase of the research project. We continued the investigation of office work at the San Jose Research Laboratory by taking a "vertical" sample from the administrative professional and the administrative managerial hierarchy.

METHOD

Within our overall goal of understanding the nature of office work, we were particularly interested in research supporting the following objectives:

1. Isolate those administrative procedures and tasks benefiting most from technological support.

   We hypothesized that in several administrative areas, particularly for

those tasks requiring intensive paperwork, we would find highly structured or semi-structured (Ref. 2), easily observable procedures which could benefit from automation. However, this kind of procedure may not be especially significant with respect to increased productivity or to effective mission-accomplishment.

2. Identify "high impact" procedures and tasks carried out in support of the office mission.

   On the other hand, it would not be surprising to observe significant procedures or tasks which, because of their less structured nature, would be difficult to automate yet which may be valuable contributors to productivity enhancement within the function.

3. Identify impacts on the organization.

   An in-depth look at procedures and tasks is likely to identify areas in which changes in the organization could be beneficial in streamlining the work undertaken to support the mission. We did not want a narrow focus on technology or automation to overshadow the direction or magnitude of organizational impact which could result from our investigation and any subsequent ramifications.

4. Develop measures for establishing baseline performance effectiveness.

   Introduction of computers has at times led to optimization of the wrong tasks and to loss of perspective with respect to valuable tasks. It is important to establish a baseline prior to making changes so that on-going measurements can be taken to gauge effectiveness with respect to office productivity. We are interested in changes that can be related to

improved effectiveness, not in change for the sake of change. We hope to discover dimensions and indicators for productivity-related measurements. In the past, too many measures of office worker productivity have been based on the easily observed but less valuable tasks which workers perform rather than related to the mission of the particular office.

The underlying concern in all studies of office system implementations is productivity. If the organization did not view the introduction of computer-based office tools as a way to increase the productivity of those working in the office and thereby enhance organizational performance, no office system would be implemented. However, identifying or defining this "productivity" is a difficult task.

The traditional economic definition of productivity is oriented toward output/input measures. In an office situation the work to obtain an output (e.g., a typewritten document) may be related to a discrete part of the task (e.g., keying the input). The analyst is tempted to develop a "productivity measure" relating the resulting document to the time needed to key the content, and the measure becomes documents per hour of keying. If we then introduce a word processing system into the office, we find, magically, that office "productivity" doubles if the clerks, on the average, can do twice as many documents per hour of keying.

The question then becomes, "How good a measure of productivity is this one metric?" If the task is critical to the mission of the office, even a small increase in productivity is valuable. If the task is of trivial importance

in the overall mission, then the "doubling" of that productivity may not be worth much. Another way to gauge importance is to ask what percentage of the person's time is spent doing that kind of task. If it is small, then the overall productivity increase is small.

Determining which tasks are valuable in a particular office environment is central to a useful productivity measure. Once this is accomplished, then measures for these tasks can be determined. In the past, rather than address this issue, people have settled for easily measured structured tasks and used them for tracking productivity increases. Researchers have recently begun to examine the possibility of using subjective indicators of valuable tasks as a starting point in understanding productivity in an unstructured office environment.

Packer (Ref. 3) develops a methodology for illuminating productivity issues. He does this by a brainstorming technique to generate appropriate questions relative to performance dimensions. He then recommends an interviewing technique to elicit from office personnel the measures of performance on these dimensions. He uses perceptual maps to plot the comparative shifts resulting from changes; e.g., the introduction of new technology. A key point in Packer's research is the distinction between the traditional productivity approach to measuring <u>outputs</u> and the more appropriate measurement of <u>outcomes</u> required by the intangible nature of the office mission.

Our similar approach in this research is to learn through the interview techniques which tasks are valuable in achieving the office mission and then

to devise measures for these tasks. The critical success factor method described below and used in our interviews helps identify these outcomes of office work.

B. Critical Success Factors and Office Analysis Methodologies

In order to carry out the interviews, we developed a methodology which is a hybrid of two existing methodologies developed at MIT: Critical Success Factors (CSF) (Ref. 4, Ref. 5) and the Office Analysis Methodology (Ref. 6). The interested reader should consult these source documents for detailed descriptions. Here we will describe the approaches in general and how they furthered the achievement of our research objectives.

The Critical Success Factors method was developed at the Center for Information Systems Research (CISR) as a way to communicate with a manager about the nature of the managerial job. It helps us to focus on those tasks and activities which lead to successful results needed for the mission of the office to be accomplished. The objective in the use of the CSF method as it was originally developed was to translate the general information gathered during interviews into requirements for an information systems plan. Because the method turned out to be a valuable aid for communication between manager and analyst, its use has grown significantly, and it is currently being employed in many facets of general business planning (Ref. 7). We saw the CSF method as an excellent starting point for identifying the critical tasks performed by each of the people interviewed. Figure 1 shows in outline form the central concepts in the method.

CONVENTIONAL	EXAMPLE	CSF	EXAMPLE
1. List goals and objectives	Increase sales 10%	List goals and objectives	Increase sales 10%
2. ---	---	State what must be done to achieve the results	Enhance corporate image through advertising
			Establish new geographic markets
			Retrain the sales force
			Offer incentives to customers
3. Measure performance with respect to goals and objectives	Sales increased 5%	Measures of performance for CSFs	Track exposure through clippings, formal market research
			Monitor introduction to new markets
			Course evaluations and actual marketing force performance
			Monitor current effect compared to historical pattern
4. Lessons learned or action to be taken	???	Diagnosis	Some media satisfactory, others inconclusive
			Retraining pace slow
			Incentives had marginal impact

Figure 1. The table shows an example of success factors for a Marketing Manager. A conventional approach to goals and objectives is compared to the more detailed insight available from use of the Critical Success Factors method.

The Office Analysis Methodology (OAM) results from extensive work at the MIT Laboratory for Computer Science. The original focus was on identifying and building technology to support future office systems. OAM fits together well with CSF because of its top-down, mission-oriented vertical cut at studying the office. In addition OAM provides a method for getting at the detailed information needed to understand the full scope of the procedures and tasks carried out in an office. Figure 2 shows a comparison and contrast between conventional requirements analysis and the OAM.

The benefits derived from combining these two methods in the interview process are several:

1) The CSF method provides an approach which works well in communicating with people who have managerial responsibility.
2) Use of the CSF method can lead to identification of the most important managerial activities carried out in support of organizational goals.
3) The OAM maintains the CSF "strategic" approach while aiding us in ferreting out important details.
4) The OAM helps to avoid problems of a suboptimized focus on the wrong tasks and of "cementing in" archaic procedures.
5) Both CSF and OAM provide the opportunity to identify the valuable contributions each worker makes in accomplishing the office mission.

In interview-based research such as this, the question often arises: does a methodology provide an important aid in eliciting information which would otherwise be overlooked, or is the quality of results dependent mainly on the skill of the interviewer/analyst? The CSF and OAM methods have proven to be valuable aids in many trials by different people -- both researchers

CONVENTIONAL	OAM
Look for processes structured enough to be completely automatable	Focus on requirements of functions within the organization (not on operational details)
Concern with specific procedures instead of functions	Orientation on functions and resources which are then supported in procedures
Look for a single system approach	Functions can be supported by a variety of procedures, alternative system approaches
Little attention to behavioral and managerial aspects of system design	Concern for decision-making role of office staff at all levels
Focus on the need for change and the technology which can be applied to change of low level tasks	Concern with organizational needs of the group under study across all levels
How much managerial time is spent looking for documents	How many hours each by how many people does it take to complete a procedure; how often per week is it repeated how many procedures are in process at any one time
How many forms are filled out per unit of time	How many resources are in process in a unit of time to carry out a business function

Figure 2. The Office Analysis Methodology permits a focus on functions and procedures important to the mission of the organization. This contrasts with a conventional approach focused on the technology used to support office procedures.

and practitioners (Ref. 8). However, as it is clearly stated in documents describing both approaches, the skill of the interviewer is important. The skills most critical are those of a good consultant -- the ability to listen carefully to what is said (and sometimes to notice what is not said) and to create a framework which integrates the responses of each person interviewed into an interpretable whole for the person. That, in turn, allows the

integration of the responses from the sample into coherent observations. We do not minimize the value of these interviewer and analyst skills.

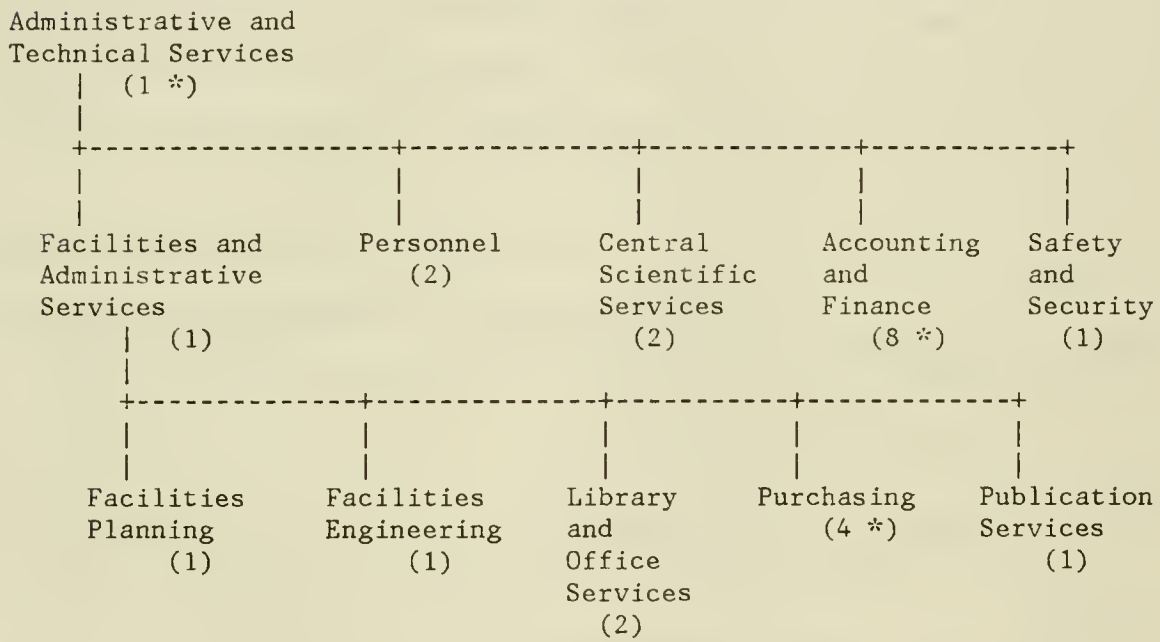
C. The Study Site

The administrative staff at the San Jose Research Laboratory supports four major research areas of Computer Science, Physical Science, Storage Systems, and Applied Science. All centralized administrative tasks are combined at a functional level known as Administrative and Technical Services which reports to the Laboratory Director. The 18 interviews sampled the administrative staff which, including secretaries, contains about 90 people. A schematic outline, listing the number of people interviewed in each area, is given in Figure 3.

Access to computer function was through desk-top cathode ray tube (CRT) terminals with monochrome display of 24 lines of 80 upper- and lower-case characters. The CRT terminals were attached to a large-scale host computer operating the VM/CMS system. Also attached to the system, directly and through a network, were a variety of printing devices for production of paper output. The network also linked computers in most IBM laboratories worldwide. People in the study used a large number of macro programs for full-screen editing, document formatting and printing, and for communication both locally and remotely over the network. An important feature of the environment was a sharing of example templates for producing documents, of news about macros, and of useful procedures for getting results in each user's personal workstyle.

The interviews were carried out with administrative managers and staff. Two distinct managerial levels were involved:

1) Group A managers -- 4 of the 10 in this group had formal positions as managers of managers; secretaries supporting these managers report to a central administrative manager. Six others included in this group had similar responsibilities but did not hold the formal position.



* Six of the 13 people in these units served as pre-survey interview test participants. While they are not formally part of the interview sample, their input has influenced our overall observations.

Figure 3. Schematic outline of administrative services at the San Jose Research Laboratory. Each of these units is headed by a manager. The number given with each category represents the number of people interviewed (including the manager). Special emphasis was placed on some areas perceived to have special potential for forms processing, an application area of interest to one of the research projects at the SJRL.

2) Group B managers and administrators -- 5 were people who have staff

people reporting to them, none of whom were managers. In addition 3 administrators with "manager-like" responsibilities were included (e.g., purchasing agent activities).

From both our previous research experience and from pretesting our ideas in the San Jose environment, it was clear that there is a difference in the nature of work in these two groups. We therefore used the CSF and OAM approaches to develop one general-purpose interview outline with a separate part for each group as a guide for capturing the most important and essential information from each group. These are included in Figure 4.

COVER SHEET (For All Participants)

Name, Title, Organization, Number of years with IBM, Number of years in current position

INTERVIEW OUTLINE (Group A)

MISSION Statement / Organization Chart
What is your own, your organization's, measure for doing a good job?

RESOURCES
People - who, how many, management levels
Other Resources

MAJOR TASKS / PROCEDURES
Phases
Initiating, Managing, Terminating
Ways to Elicit - Calendar, Review of days, list of documents
Inputs / Outputs - Tangible and Informational
Sources and Destinations - Links
Exception Handling
Objects
Databases
Quantitative Measures
Office Layout / Environment

(Figure 4 continued on next page)

INTERVIEW OUTLINE (Group B)

Confirmation of Mission (as gained from earlier management interviews)

Is there one (or more than one) "object" that you work with more than 10% of your working time during the week?

A Specific object (ask about Normal Case;	OR	General experience with objects Exceptions, Extremes for each)
Origin		Length (pages)
Number you do per week		Percent of your time
Elapsed time		Number of people involved
Errors, Changes		Correction procedures
Communication		Attachments
Peaks and valleys		Priority
Routing		Distribution
Tracking		Filing
Retrieval		Auditing
Security		General satisfaction

GENERAL QUESTIONS (for all participants)

1. Indicate percentage of time (weekly) spent in:

Communication	Text production (letters, memos, reports)
Forms (filling and processing)	Budget and financial tasks
Scheduling / Calendaring	Sorting / Reading mail
Copying	Professional affiliation work
Travel	Other (specify)

2. Do you make use of a computer terminal?

3. What is your use of the telephone

4. If you had more free time, how would you use it?

Figure 4. The interview forms were filled out by the interviewer, not the participant. These headings were supplemented with detailed categories to aid the interviewer in a thorough job exploration with the participant. As indicated, the forms were different in focus for the two management groups.

Group A managers were queried about the mission and scope of their responsibilities, where the focus was on the most critical. Group B people answered general questions confirming for us their mission. We then asked them to focus on the procedures and tasks that predominate in their work, where the interviewer elicited detailed information on specific activities.

INTERVIEW RESULTS

As we describe below, the nature of work in each of the two groups differed. What we observed is not in conflict with what has been said in the past about the nature of managerial work. But what is interesting here is that the difference between the two levels of management is so clearly drawn and easily characterized. These differences say a great deal about the office systems requirements in each group.

The job of the Group A managers is characterized by variety and diversity. This is primarily because the tasks at this level are rarely structured, but most often are in the semi- or un-structured category. The environment is communications-intensive and interrupt-driven. It is easier for these managers to describe generic activities associated with their jobs than to outline specific tasks and procedures. The predominant activity they perform is exception-handling. When either the stated policies and procedures fail to cover a task, or when the subordinate level of management asks for help, tasks come to managers at this level. Figure 5 summarizes these characteristics.

Variety and diversity

Communications intensive

Consists of semi- and un-structured tasks

Predominently exception handling

Interrupt-driven

Figure 5. Characteristics of Group A jobs.

In contrast, the Group B people tend to focus on single (or a small number of) recurring procedures (see Figure 6). The tasks are either structured or semi-structured, and corporate policies and procedures guide the majority of the work.

Focused on single or small number of procedures

Consists of structured and semi-structured tasks

Interpret established policies and procedures

Recurring and repetitive actions

Figure. 6. Characteristics of Group B jobs.

These differences in the nature of work help to define differences in requirements for supporting the two groups of managers. Because there is little structure to or similarity between the important aspects of Group A jobs, office systems that facilitate structure and repetitive tasks will be minimally useful to this group. Such systems may have value in speeding the managers' work in the mundane part of their tasks (e.g., a full screen editor engineered for high throughput of standard text as found in messages and supporting easy text correction). This can free time for the more complex and valuable tasks important to the managers' mission. Systems for this group should address the information retrieval, communication, and flexibility aspects of the job. Support for the work of the Group B people must focus on structured, repetitious tasks; therefore, systems designed to support such work are of potential value.

Malone's work (Ref. 9) in investigating how people organize their desks is of interest here. He points out that there are two important functions reflected in the piles of documents in an office: a finding function and a reminding function. While our two groups of managers need both functions, the different natures of their jobs suggest that the reminding function may be more significant in the unstructured, diverse jobs of the Group A managers. The Group B people need a more intensive finding function to locate supporting data since they are processing documents according to a standard set of rules and procedures.

Malone also characterizes his case studies on the basis of whether their desks were messy or neat. In addition to the obvious effect personality will have on this characteristic, the nature of the work differed in the two categories. The messy-desk person had a less structured, less routine job than the neat desk person. Malone's observations fit well with ours and support the need for understanding the differences in work.

In addition to looking at the procedures and tasks of those interviewed in the standard OAM vertical slice way, we also gathered information to understand the percentage of time spent in various activities (Figure 7). We found that the Group A managers spend anywhere from 35% to 80% of their time communicating: in meetings, in one-on-one conversations, and on the telephone. Three quarters of these managers spend over 50% of their time in communicating activities. Text composition, which for these administrative managers is primarily memo and letter writing, accounted for from 5% to 30% of their time, with one third of the sample averaging over 20% of their time in this activity. In this group, 5% to 10% of the managers' time is taken up

in working with forms. Since our sample is composed of managers in administrative positions, this percentage may be high in comparison with a general manager. The final two categories are mail processing, (2 to 20%) and other tasks (such as budgeting, calendar management, copying, travel, and professional affiliation work) generally taking less than 5% of their time.

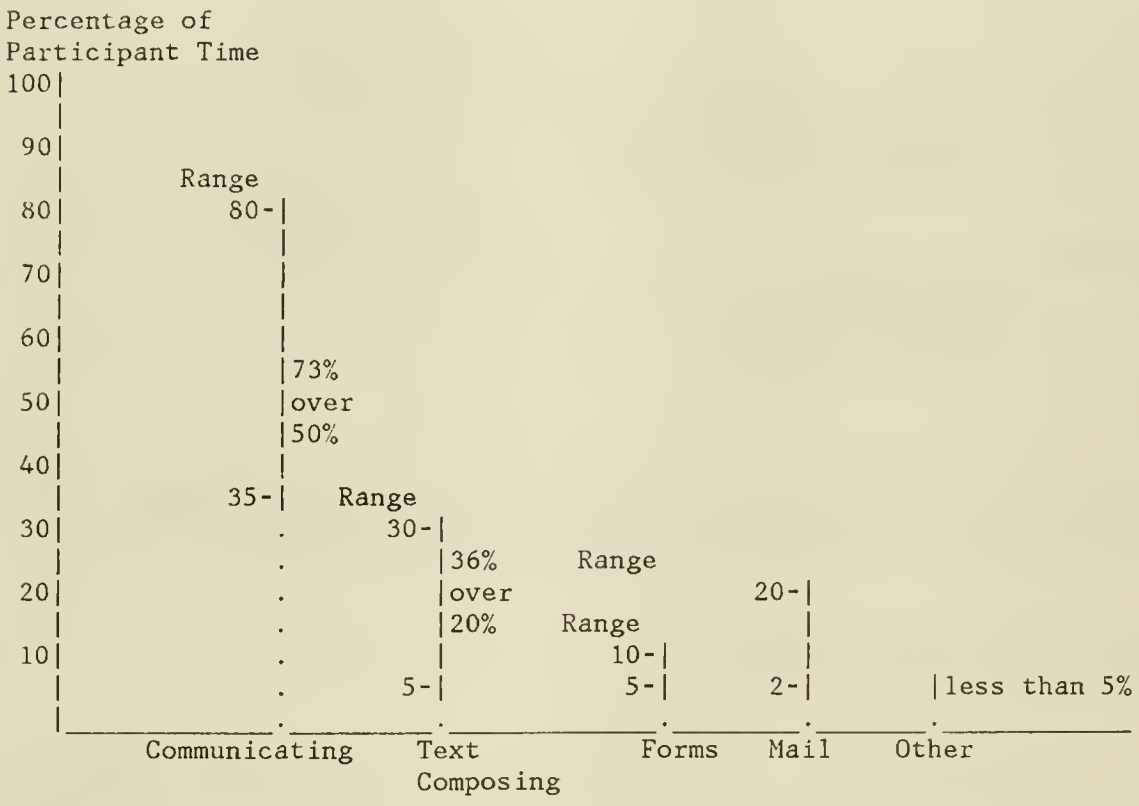


Figure 7. The Group A managers show a great variety and diversity in the number of activities and the amount of time spent in each.

It was considerably more difficult to look at the work of the Group B people to obtain a parallel set of percentages across tasks (Figure 8). In all cases these managers spend most of their productive time in support of either a single general procedure or only a few procedures. For example,

the personnel in the purchasing department spend their time processing purchasing orders. This involves a variety of discrete tasks, including getting details from the person ordering, contacting and negotiating with vendors, placing the order, preparing back-up paperwork, and tracking orders until they are received, delivered, and found acceptable. Each of the discrete tasks varies considerably across a variety of items handled depending on the circumstances of each order.

50% spend 100% of time in support of a single procedure
(requires a range of sub-tasks)
e.g., processing purchase orders

50% spend discrete percentages of time in support of a group of procedures
e.g., monitoring accounts
analyzing budgets

Figure 8. The Group B people are split evenly between supporting a single procedure and spending time on a group of related procedures.

OBSERVATIONS AND INTERPRETATION

The key point which comes out of this research is that managerial jobs in administrative areas differ from each other in important ways. These differences (i.e., Group A managers spend major parts of their time in communication, Group B people are oriented toward procedure execution) are significant in determining which office system technologies and which applications are appropriate in each situation.

Our interpretation of the research results will be discussed under each of the four original research objectives. The SJRL provides an ideal laboratory for this research because of the computing power available to the personnel and their creativity in employing it. Our observations on the advanced application of technology are made possible by the imaginative use these managers were making (or planning to make) of their display terminal connected to a host computer.

1. Isolate administrative procedures and tasks benefiting most from technological support.

Structured procedures can benefit from technological support, and in some instances automation has already been achieved. For example, the personnel interviewed in the Purchasing Department make extensive use of a small group of telephone numbers to reach the vendors with whom they most frequently deal. As a result a good business case was made for automatic dialing enhancement for their telephones. They are very pleased with that feature and use it extensively. However in the area of tracking purchase orders after they have been initiated, they follow a cumbersome procedure in which they must get information from more than one computer system. While there are historical reasons for the two systems, it is clear from our research that better support could be provided for this task. Another example comes from the Accounting and Finance department where much of the processing of travel reports is done manually. Relatively simple automation support could improve time of processing and the correctness of the budget expense information available to management.

To the extent that the diverse jobs of the Group A managers contain structured aspects, office systems can be designed to relieve them of mundane procedures. Examples are aids for access to reference material (reminder files, telephone listings, message logs), and support for scanning personnel data and forms. Using our methodology, it is relatively straightforward to identify these areas where, because of the structured and recurring nature of the task, it would be beneficial to automate the process.

2. Identify "high impact" procedures and tasks carried out in support of the office mission.

To review, these are areas where, because of the direct value of the procedure in accomplishing the mission, enhancement through technological support could significantly impact the "bottom line" in terms of managerial productivity.

The Critical Success Factor method was valuable in helping us piece together the processes followed in these areas of managerial work. Observations are more difficult than in the first Research Objective because the procedures and tasks here are semi- or un-structured. Communication is clearly an important activity. The use of the internal mail/messaging capability at San Jose was growing at a fast rate. At the time we were conducting these interviews, all but two of the people we talked with were using terminals or had them on their desks and were waiting for connection. They were all using or planning to use the message system. It was seen as an important way to save time lost in missed telephone connections and to establish an agreed-upon time for face-to-face conversations. The importance of

mail/messaging systems in managerial communication is being widely studied and observed (see, for example, Ref. 10, Ref. 11). The messaging system at the SJRL plays a central role in introducing managers to the communication aspects of office systems and in encouraging the managers' interest and use of the system.

Other tasks viewed in this category had a similar theme of saving managerial time. For example, managers in Personnel had begun to use the computer system to keep notes from meetings so that producing a final written document could be done online from the notes. In fact, one reached over to his terminal and made some notes during our conversation.

A second major category in this area is general managerial support. The managers as a group saw the computer as an aid supporting their personal workstyles by providing quick reference to lists, reminder files, budget information, and written documents. Because of the variety and diversity across managers, and even for the work of a given manager on a given day, access to a broad range of tools is valuable. Kotter's work (Ref. 12) focuses on this aspect of the job: "The managers do not function in a crisply defined environment or direct through formally delimited channels ..."; rather, "they must find ... what to do despite great uncertainty, great diversity, and an enormous quantity of potentially relevant information". Designing an office system to support this aspect of managerial work is the challenge and is where the significant payoffs lie. Figure 9 summarizes some of the specific examples of work we saw in this area.

Communication	Managerial Support
Messages	Project databases
Text production	Budget monitoring
Inquiry into human databases (e.g., computer conferencing)	Inventory inquiry
Telephone enhancements (e.g., auto dial, redial links with databases)	Analysis, spreadsheet calculations
Calendar management	General database inquiry
	Logs of activity (e.g., messages, memos)
	Reminder functions
	Finding functions (e.g., personal file creation, information classification, information retrieval)

Figure 9. Support for general managerial tasks. These functions are used potentially by all managers but with an unpredictable frequency, intensity, and urgency.

In all interviews we asked the managers what they would do with any "spare" time afforded by the technological support of some of their tasks. This question, inspired by the CSF method, leads to insight on personal critical success factors that may have been overlooked. In almost every case, the managers responded they would put effort into one or two longer range areas that currently were neglected because of day to day operational pressures. The familiar "catch-22" scenario often appeared: a manager knew that attention to a critical area could mitigate daily operational problems, but the manager had not been able to find time to give it the level of attention needed to obtain results. Figure 10 summarizes some of the specific areas the participants mentioned.

3. Identify impacts on the organization.

Clearly there will be direct organizational impacts from automating, changing, or supporting the kinds of tasks we identified. Automating some

How Managers Would Use "Free" Time

Pay more attention to existing critical success factors

Attack new areas which are neglected because of operational tasks

Organize more tasks that could be facilitated
by having them supported on an office system

Personal and employee professional development
(e.g., career planning, education)

Communication, networking with employees

Figure 10. Managers gave their opinion on how they would use free time. This can be an indicator of critical success factors.

of the structured procedures will entail changing processes which have been in effect for years. People will have to learn new ways of doing old things, and some current tasks will become unnecessary. Resistance can be expected to these changes from those who interpret almost all change as negative. However, some changes will have positive benefit. For example, the message system can lead to the death and burial of "telephone tag". In another case, while facilities planners will have to learn new ways of "drafting" to use automated systems, this new tool can help in office layouts and in the monitoring of space and planning. As a net benefit, it should significantly decrease the amount of time they spend in the clerical task of representing their ideas in mechanical drawings. It will also allow them to communicate rapidly their ideas and actual plans with facilities people in other geographic locations. The ultimate effects of all this increased support for communication is difficult to predict, but there is no doubt that there will be effects on the organization.

4. Develop measures for establishing baseline performance effectiveness. While we did not develop specific measures in this phase of the research, we do feel that we have made a good beginning at understanding the relevant dimensions upon which measures can be developed. Because the methodology helps us to focus on those things managers do which are valuable in accomplishing their mission, we can begin to identify logical, reasonable indicators of managerial productivity. The CSF method includes a similar step in which the manager being interviewed indicates what it is that is important to measure. Consistent with the Packer approach to gaining insight on intangible aspects of productivity as discussed earlier, this is a structured procedure for gathering information on subjective matters.

For example, in the case of the Purchasing Department personnel, their mission is not to process purchase orders, but to provide a service to the SJRL that the professional staff they serve will view as responsive and cost effective. Therefore, a simple count of number of purchase orders processed in a day or week is not a good measure of productivity. A record of customer satisfaction in terms of having received the correct product (in a reasonable amount of time and at a competitive cost) is a measure of service. Having the service requested, procurred, delivered, and evaluated online could be a major advance. As an example of an easy way to acknowledge satisfactory receipt, members of the professional staff have reported to us that they find using the online message system to verify routine or expedited delivery is a much lower barrier than making a more formal phone call (and then being annoyed to discover that the phone is busy).

Another example given to us by a Group A manager in the Personnel Department is that his productivity is not simply measured on the number of qualified candidates who get interviewed. In addition, he is measured on his ability to interact with the technical managers in the SJRL, understand the educational needs of their departments, and to design and execute programs that fill these needs.

OBSERVATIONS

Consistent with our observations in the first phase of this research (which focussed on secretarial support roles), the commonly held stereotypes of what managers do and don't do fall apart under close observation. These managers do not exhibit the stereotypical attitudes toward technology and keyboards. In the majority of cases, the managers were open and willing to learn about technology that could benefit them. However, their motivation was clear -- "Show me that it will help me and I'll try it. But don't give me a technical toy for the sake of looking futuristic".

It is our opinion that those managers who resist the idea of technological support may reflect insecurities with respect to their job environment. Thus, any force with potential for disturbing the status quo may be threatening. Solution of such problems requires higher management attention to the personal situation. Technology merely triggers the reaction.

At many locations the Information Center concept is proving useful for support of individual administrative professionals and managers (see, for example, Ref. 13). Our study reinforces the need for tools designed to match the processes of individual users, readily accessed terminals that can be placed unobtrusively in the office, and support personnel to train, guide as consultants, and assist users with immediate problems.

- Tools. Tailoring of the services made available to the participants in our study was very important. Macro procedures and model templates developed by one member of the administrative staff, with technical assistance from computer-sophisticated members of the Computer Facility, were well-received by colleagues.
- Terminals. The decision to provide a terminal for the exclusive use of each individual gave ready access to function when and where needed. This support for incorporation of function into daily work practice far outweighed occasional problems caused by size and ambient lighting requirement problems of a display terminal on a desk.
- Support. One member of the Computer Facility took a personal interest in the activities of individual users, and this level of support made the difference between success and failure when some users were faced with the more challenging aspects of current systems.

Though the SJRL did not have a formal Information Center, we can echo the Infosystems article caution on staffing. The condescending technical expert who regards user routines as "toys" because they make inefficient use of machine resources totally misses the point that the scarce and expensive resource in the office is the time of professional people.

COMPARISONS WITH OTHER CISR STUDY SITES

In general, the observations at SJRL are consistent with observations at other sites where this office systems research is being carried out.

At a large aerospace corporation the contracting office was studied in depth. The same patterns of variety and diversity appear at upper levels of management. The need for office systems which address structured, repetitive tasks exists for lower levels of management. In addition the importance of the information retrieval function in the managerial support component is particularly significant.

At a major Eastern Manufacturing Corporation, the use of a variant this methodology is leading toward a strategic office system plan. In this case the method has been valuable in helping to factor stereotypical beliefs from actual system requirements. The population being studied here is not limited to administrative managers but rather includes all managers in an operating division. The methodology also helped an internal task force to better understand the company-specific "cultural" aspects of the office work. This understanding is providing valuable insight into general office information needs. As a result, two pilot studies are being planned which could lead to an integrated office information system providing both office systems support and links into the traditional information data bases of the organization.

Two important observations come out of work at the five sites where we have actively used this methodology. These are supported by informal

reports from 20 others.

1) Careful office systems analysis reveals important insights into both the generalized nature of office work and specific cultural aspects of each organization. The latter must not be overlooked in planning support systems for the office.
2) "Office systems" analysis uncovers a need for a managerial support system that includes information ordinarily provided by the information systems department. This makes intuitive sense since we consider office systems to be a piece of the information systems puzzle. However, as the Information Systems (I/S) function evolves (Ref. 14) to a managerial support function, the integration of office systems with more traditional information systems becomes increasingly important.

REQUIREMENTS

As we examine the requirements for computer-based function to support the work of managers such as those in our sample, it is good to have a model of managerial work in mind. Office work is based on person-to-person communication. The series of steps involved in getting results via this communication includes:

1. Making requests and receiving promises for action,
2. Discussing and negotiating to make clear the assignment and the responsibility for the result,
3. Following up on and reporting on progress toward and barriers in the way of obtaining results,

4. Redirecting assignments, acknowledging failure, or renewing commitment,
5. Receiving and delivering results,
6. Acknowledging completion of the assignment.

Communication in each of these steps (which may be continuously recurring each day, both with respect to a single assignment and with respect to multiple, independent assignments) is carried forward over a time period.

The traditional view of office work is that it is carried on by management and staff. However, the steps outlined apply in any network of person-to-person interaction and are required for mutually-agreed commitment to results. An analysis of work in any current office would show events associated with these steps. We are interested in this section in examining how computers can be applied to support and foster mutual commitment to results of value in the mission of the office.

Some representations found useful in current offices are likely to carry over to automated offices. For example, Miller has observed that a well-designed form can serve as a kind of "contract" where all and only the data required to achieve a result (whether obtaining a travel advance or approving a promotion) is included (Ref. 15).

The natural enthusiasm of current experts who feel well-supported by computers, the widespread advertising campaigns in media viewed by managers, and the flood of function available on personal computers are all leading to high expectations on the part of those entering into computer use. In actual practice, many of the currently-available functions are not well suited to the characteristics of the managers we

have been describing here. Our research results lead to some clear statements about requirements for managerial workstations as administrative people shift from watching demonstrations to taking over the controls themselves. The design challenge is particularly noticeable for higher level managers.

A. Reliability is critical.

Effective managers and administrative professionals often have a personal commitment to the delivery of work results. When a computer "lets them down", the fact that this condition is beyond their control does not mollify them. This is especially true when managers use a text processing tool, designed to be highly-tuned and appropriate for their needs, to compose on-line a carefully worded response to an exception situation and then discover loss of the creative work due to computer failure. The level of personal commitment of managers to creative results can be contrasted with reactions in some data entry pools when unavailable service forces a welcome "extra break".

We have observed repeatedly how communication activities are of prime importance to higher managers. If message/mail systems are to be accepted and incorporated into work patterns, they must become as reliable as the telephone. The exchange of a personal telephone message leaves both parties with a sense of completion. Playing "telephone tag" through a message center is currently unsatisfying. The value of asynchronous computer messages have been noted in many places (e.g., Ref. 11). To give a sense of closure which is equivalent to that of the person-to-person telephone call, the sender must be able to find out if (and when) a

message was received and, if necessary, to inquire about progress of the message toward the destination.

B. Flexible access is needed to a variety of services.

The key to successful movement of the current structured functions found on computers into the interrupt-driven, unstructured world of the higher-level manager will be found when designers learn how to support the manager who needs to string together parts into a whole. A diversity of function is beginning to become available. Unfortunately, the incorporation of this function into the manager's style of use is not so easy. Often the "process of use" currently requires knowledge of esoteric, computer-oriented facts -- especially when something goes wrong. What is needed in a "user interface architecture" is attention to supporting standard patterns of use valid in a variety of applications. Examples of processes that can be meaningfully standardized are the way a user edits text (Ref. 16), the way a user finds data, the way a user moves content from one representation to another, and the way a user requests help in operating the system (Ref. 17), Often the output from one task becomes the input for the next. A task not completed as a result of a priority interruption leaves a thread which must be remembered, found, and picked up later.

A stable frame of reference is required (Ref. 18), one within which the user will rapidly recall function in the same way that the skills needed for riding a bicycle or driving a car are remembered and transferred to a different model of vehicle. In the case of this study, we are speaking of cognitive memory, the mental models that support manager recall of

successful use patterns. This is especially important for people with jobs requiring access to a diversity of function. The manager needing rapid, efficient use of seldom-used functions must rely on easily recalled standards for interaction. In contrast, the software architecture to support clerical work is easier to design, as that kind of office work tends to be intensive, repetitive, and buffered.

Lest too much be made of the differences between managerial and clerical support requirements, we recognize that the the secretary may have to use the manager's system to accomplish some result in the manager's absence, and the manager must be able to access clerical functions in an off-hour emergency. The support for this kind of teamwork is related to the breaking down of stereotypes we have noted above. Thus, the bounds established between functions need to be attuned to policy and contemporary practice rather than "architected" into the system.

Another aspect of flexible access to function is observed when we consider placement of function. The computer scientist observes important distinctions when implementing function in intelligent terminals, through local area networks, or as part of host services. Other distinctions arise in the difference between storing data locally and distributing data in a network. We need to think now about how to make some implementation design decisions invisible to the manager's process of use. Managers as users expect to see differences only in the cost of the service and the response time, not in the way they must interact with the system while doing their job. Services must be in a form they can relate to without obvious and intrusive intervention needed from intermediaries.

The need for flexibility is also observed in the area of communication. Because not everyone will be online and not all person-to-person exchanges are appropriate for the computer medium, the manager requires links to the customary mail system, to the telephone for both direct interaction and voice messaging, to information supporting face-to-face meetings, and to their audio and video counterparts.

In general we should be sure that the communication purpose can be separated from the medium carrying the message. Thus a message may be conveyed by a handwritten note on paper, by digitized text on the computer-printed paper, in analog (facsimile) form, delivered through the computer, or as audio output on the computer.

C. Information located in diverse sources must be found.

The information gathering needed to handle exceptions on an interrupt basis requires the manager to be able to "go where the data is" regardless of historical Data Processing and Word Processing distinctions. We observed earlier that the integration of office systems with traditional information data bases is becoming increasingly important. Malone's (Ref. 9) description of the "finding and reminding" functions also emphasizes the needs of office workers for access to a variety of information in a diversity of locations. Because artificial boundaries are traditionally placed around the purveyors of the technologies required (see Ref. 19 for a good review of this phenomenon), this will be a formidable technological and political task.

D. Rapid scanning must be supported.

In the process of finding needed facts, managers are accustomed to rapid scan of masses of data as they look for the information burried in a flood of text and figures. Formats appearing on printed forms (one page memos, forms, tabular data) serve as aids to rapid scanning. In addition to fast display response time for interactive user requests (taken for granted here as an obvious requirement), the data returned must be displayed in a spatial relationship familiar to the user and appropriate to the characteristics of the display device. For example, the representation of a form can give the user a familiar place to look for a category of information. Editors which allow for context search of a string of characters can assist scanning in a similar way when a particular pattern is sought.

Figure 11 summarizes the the set of requirements we have observed for this part of the study. It is interesting to compare and contrast the results here with the set of requirements observed earlier (Ref. 1). The outcome

Requirements for Support of Managerial Users at Workstations

	Managers	Secretaries
Reliability		
• No loss of data	X	X
• Feedback on progress, tracking to completion	X	X
Flexible Access to a Variety of Services		
• String together a diversity of function	X	X
• Standard patterns of use across a variety of applications (user interface architecture)	X	X

(Figure 11 continued on next page)

• Placement of function (in the workstation, at a network node, in a central host computer) not visible in the pattern of use	X	X
• Links to mail, telephone, teleconferences as support for face-to-face meetings	X	
Finding Information From Diverse Sources		
• Integration of information regardless of historical (e.g. Word Processing or Data Processing) origin	X	
• Overcome political barriers leading to artificial separation of data	X	
Support for Scanning Behavior		
• Formats, highlighting, search tools to assist readers in knowing where to look	X	X
Workstation Requirements for Secretarial Users		
Large-screen word-processor with local storage (programmable so that functions can be tailored to user needs)	X	X
Workstation attached to host and network services (for high quality printed output and for user communication with remote locations)	X	X
Typewriter emulation on the word processor (for handling one-time paper forms from outside the office)		X
Task switching between multiple tasks (may be active in parallel)	X	X
Local support for programs and built-in aids (e.g., for training).	X	X

Figure 11. A summary of requirements for managerial support. These can be compared with the requirements observed in our earlier study of secretarial users.

of the previous study focused on physical requirements. In the current study, we see more emphasis on the logical requirements, the shaping of the functions (typically through software) presented at the workstation. It is intesting to note that many of the requirements in both studies apply to managers and secretaries.

DISCUSSION

The topics we have covered in this case study of administrative managers include technology, politics, and human nature. It took the data processing practitioners and researchers many years to recognize that successful design and implementation of new technologies requires attention to this range of issues. This lack of recognition led to glorious failures (not formally reported in the literature for obvious reasons) in the implementation of information systems. We are hopeful that the disciplines of computer science and organizational studies can be integrated and that we can be therefore better equipped to plan, design, implement, and maintain continuous support for future office systems.

Our research observations are by no means limited in application to the work of administrative managers. We feel that what we have seen will hold true in our continuing research, where the methodology is being applied to the study of line managers and at other corporate sites.

Our research results provide valuable insight for a formidable task. In our opinion the goal in office systems design is to incorporate three

critical aspects:

- an open attitude toward the nature of work in offices;
- a sensitivity to the cultural environment of the organization and the style of the individual person;
- a thorough understanding of the productive outcomes of office work.

We believe our research demonstrates the value of this approach.

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